

Extended Capabilities in JPEG-2000

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Abstract

We present an overview of some of the extended capabilities the ISO JPEG-2000 digital image coding standard provides and illustrate potential applications of these capabilities to US government needs, focusing on scientific data-management applications related to DOE core missions. Examples are provided that quantify the effect of JPEG-2000 compression on end-use exploitation of hyperspectral remote-sensing imagery. Results indicate that, for many hyperspectral image classification tasks, it is possible to obtain better than 99% classification accuracy while using less than 1% of the hyperspectral image data, provided the data is compressed using an appropriate JPEG-2000 compression profile.

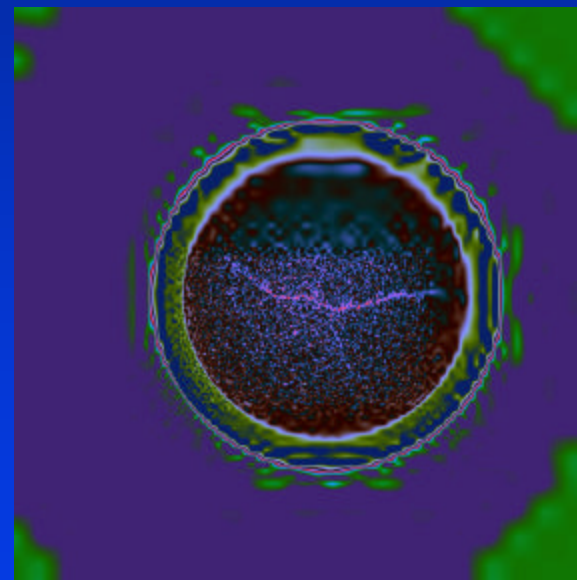
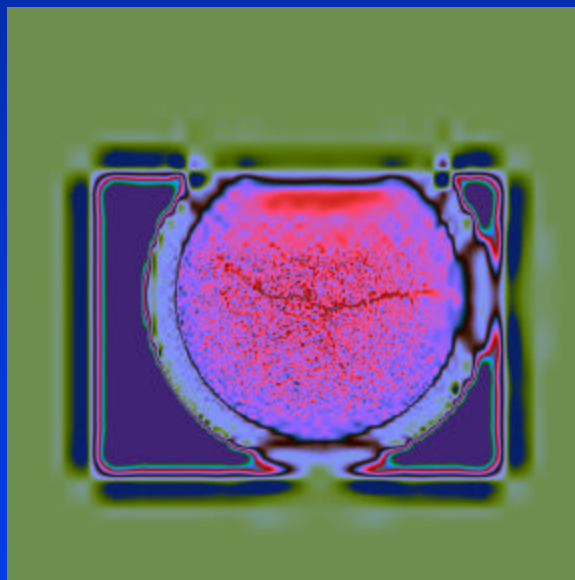
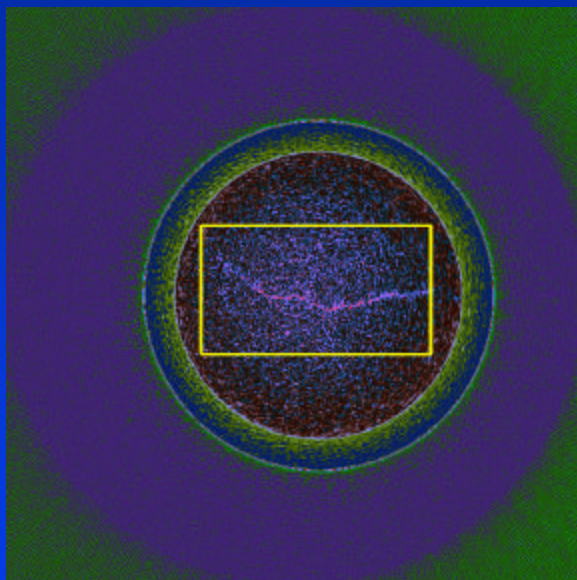
Advanced Capabilities for Advanced Applications

Los Alamos National Lab is actively participating in the development of JPEG-2000 extensions for advanced applications that support DOE missions.

- | Extended capabilities currently under development:
 - * Part 8: Image security features
 - * Part 9: Interactive client-server protocol
 - * Part 10: 3-dimensional (volumetric) data and floating point data
- | Potential DOE/LANL applications:
 - * Experimental physics imagery
 - * Diagnostic imagery (x-ray and tomographic)
 - * Remote sensing and multispectral data
 - * Time series imagery
 - * Computer modeling and simulation output
 - * Digital libraries and databases

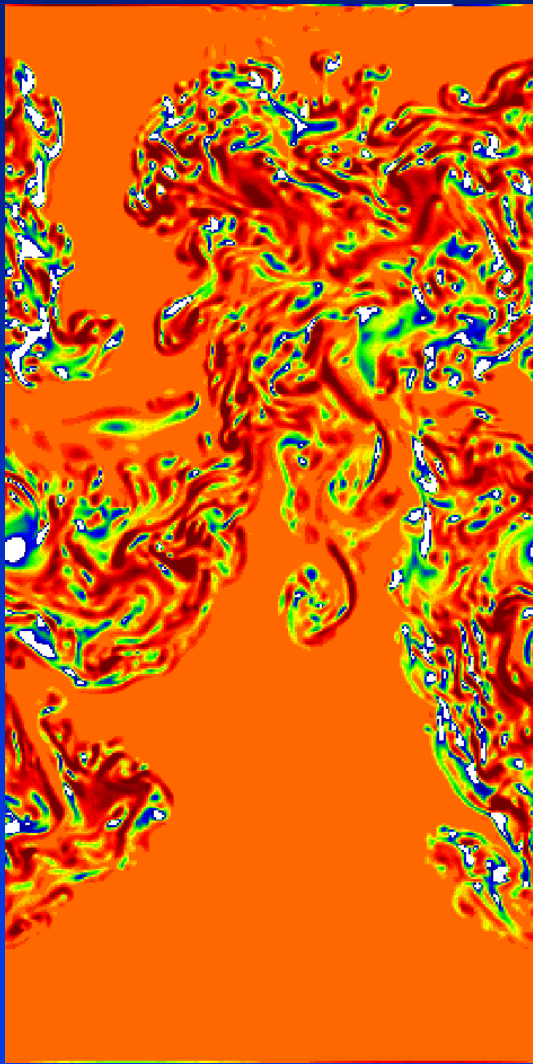
Region-Of-Interest Coding on Volumetric Imagery

- | False-color visualization for tomographic imagery of simulated high explosives
- | Original image (16 bits/sample) with highlighted ROI (L); reconstructed at 0.05 bit/sample (M), reconstructed at 0.5 bit/sample (R)

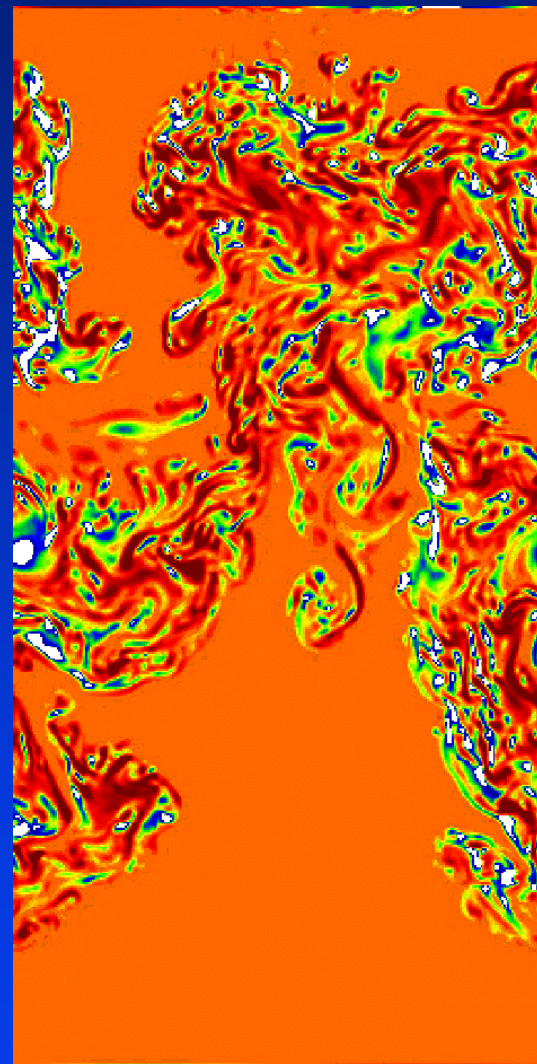


Computational Fluid Dynamics Data: Simulated Rayleigh-Taylor Instability

Original vorticity field, 16 bits/sample

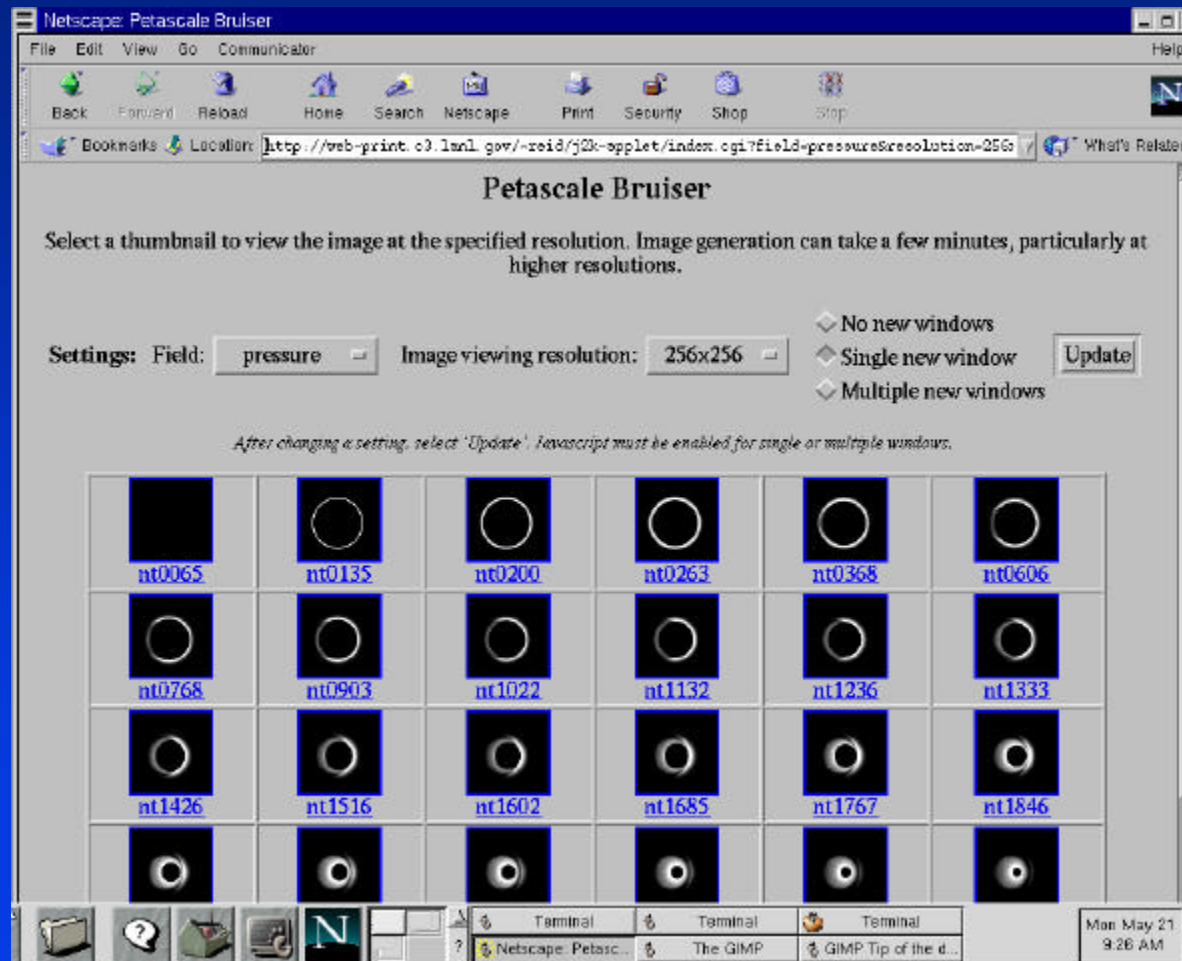


JPEG-2000, 1.0 bit/sample



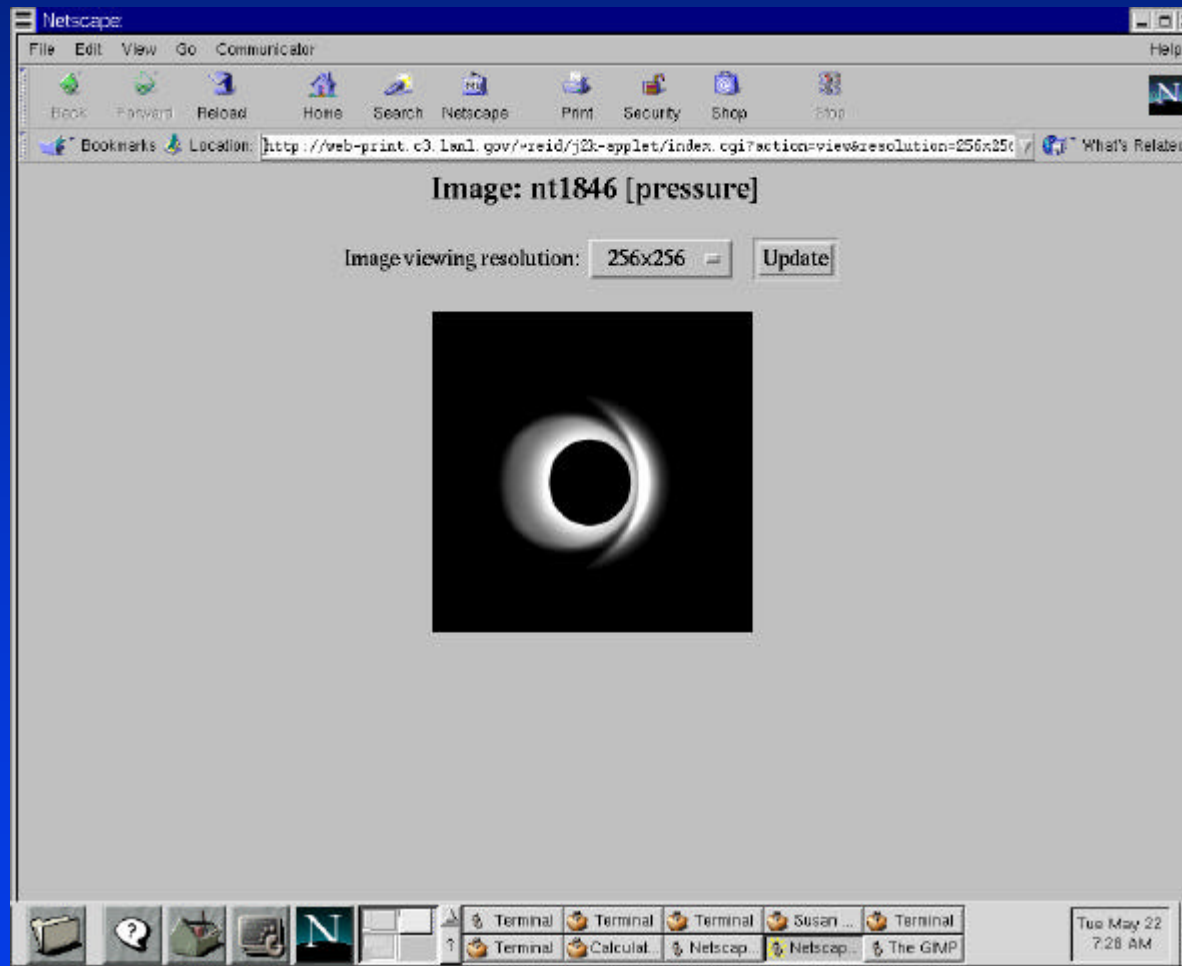
Interactive Browsing Applications

- | Browse tools will use Part 9 client-server protocol



Interactive Browsing (continued)

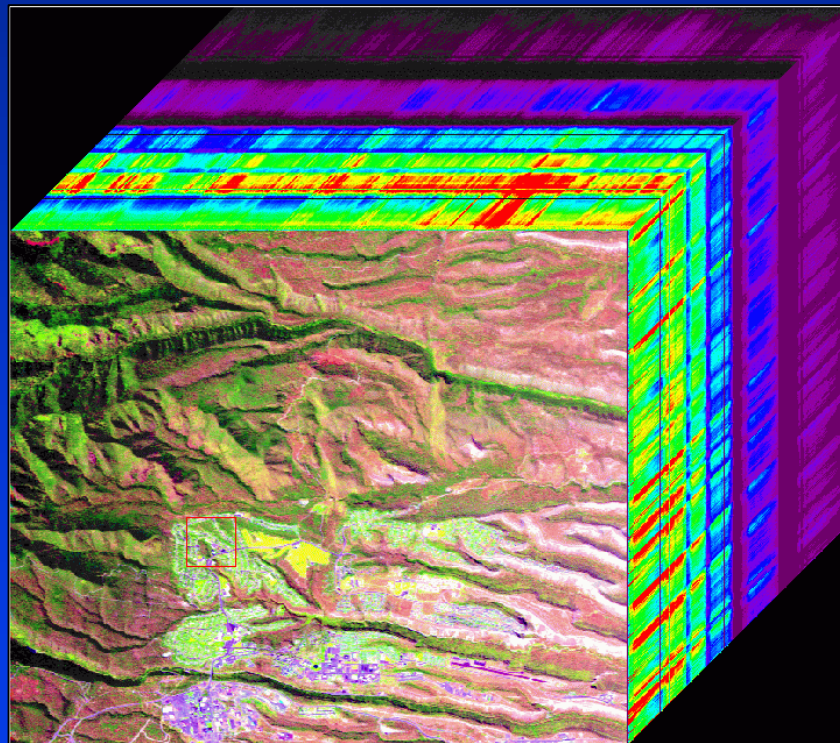
- | Progressive transmission capabilities serve up desired resolution to user



Remote Sensing: Hyperspectral Imagery

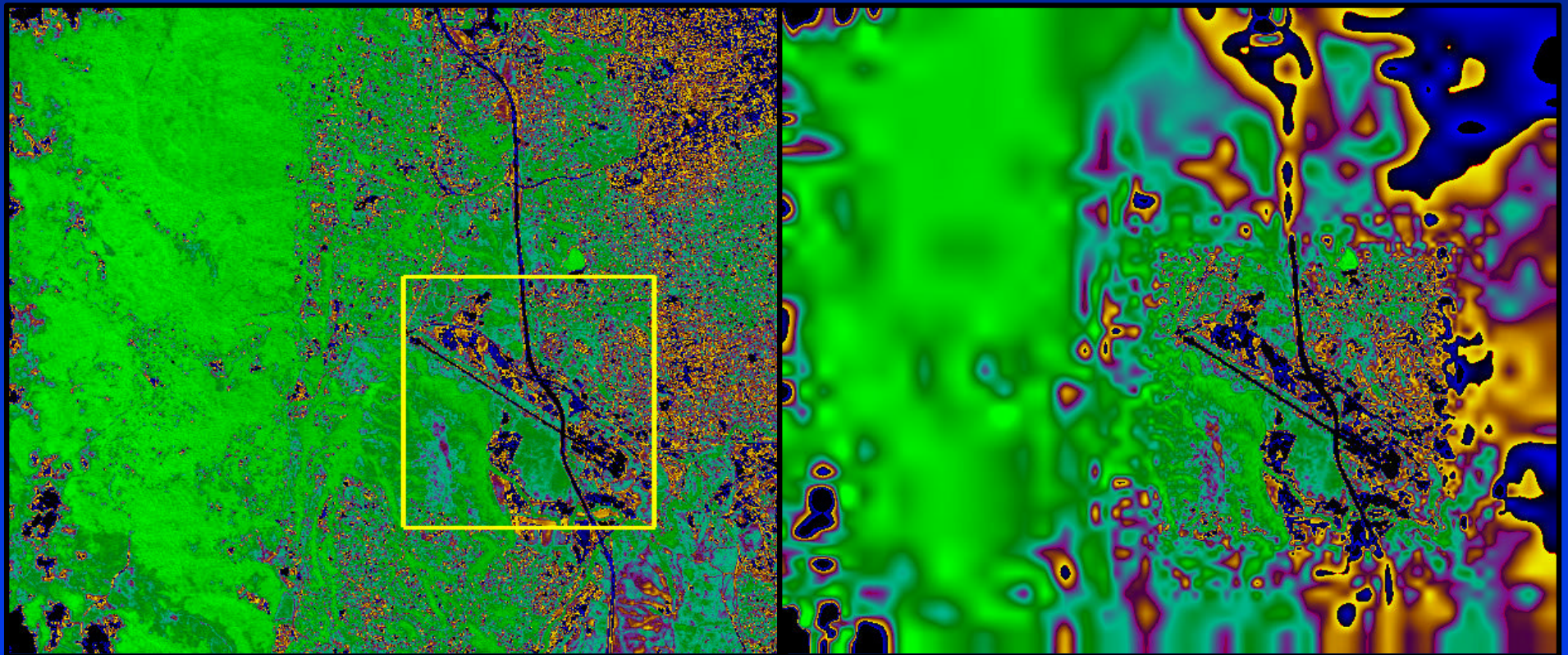
I Examples using NASA AVIRIS imagery: Airborne Visible InfraRed Imaging Spectrometer.

- * 224 spectral components (bands)
- * 140 MB per image cube



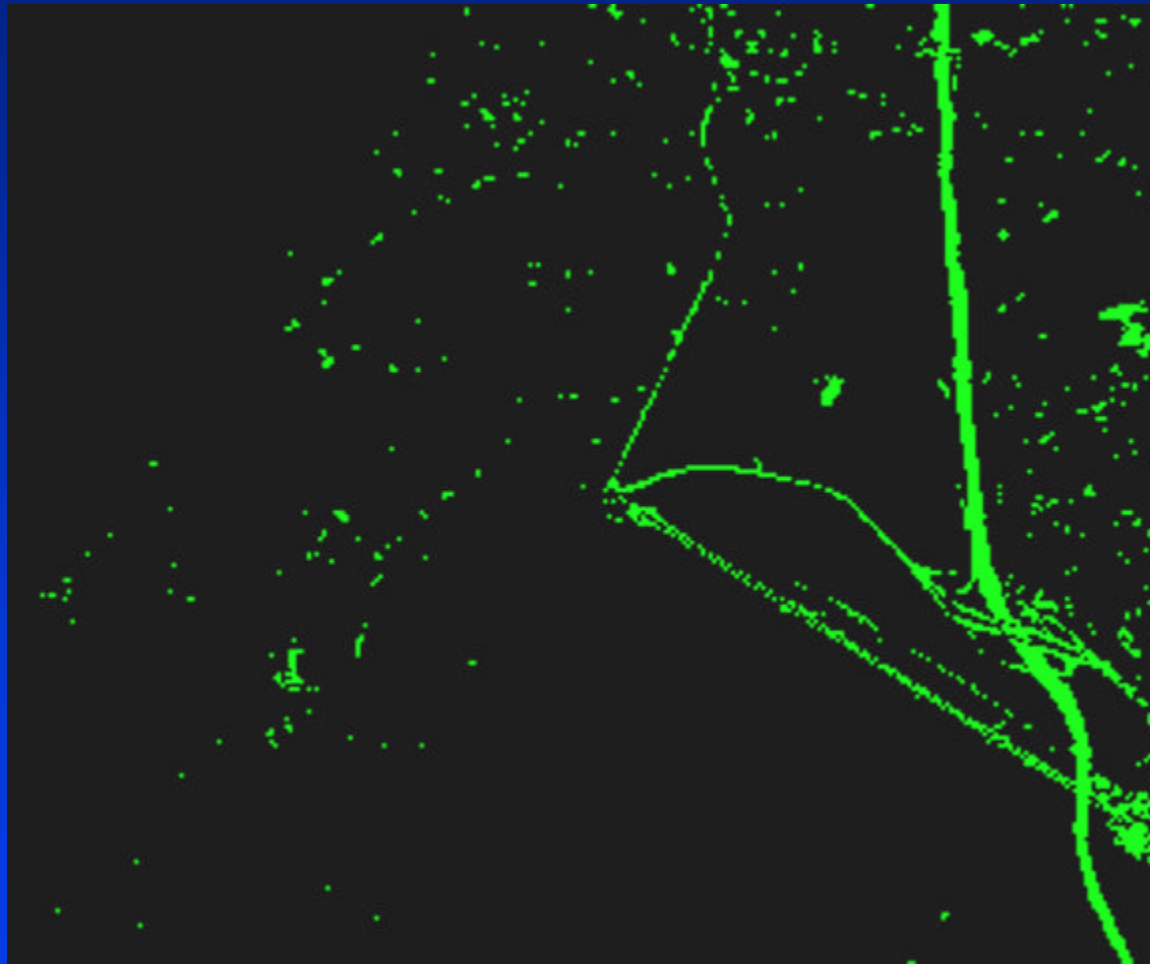
AVIRIS “Jasper Ridge” Image Cube with Region-of-Interest Coding

- | (L) Original 16-bit image with highlighted ROI.
- | (R) Partially reconstructed image decoded at 0.5 bits/pixel/band.



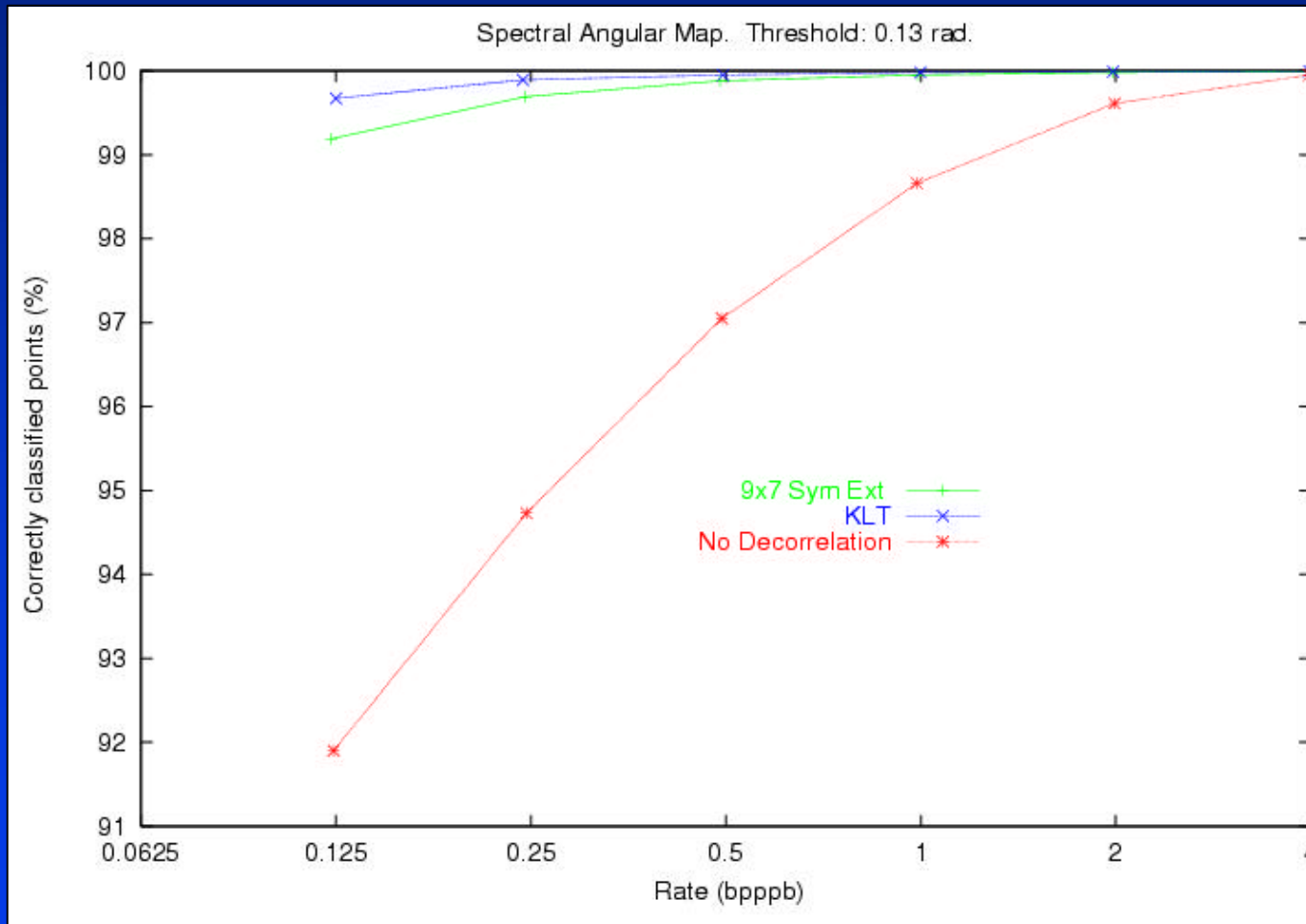
Hyperspectral Data Classification Example: Spectral Angle Mapping

- Example of a typical remote-sensing image exploitation task:
classify all pixels with spectral characteristics similar to asphalt



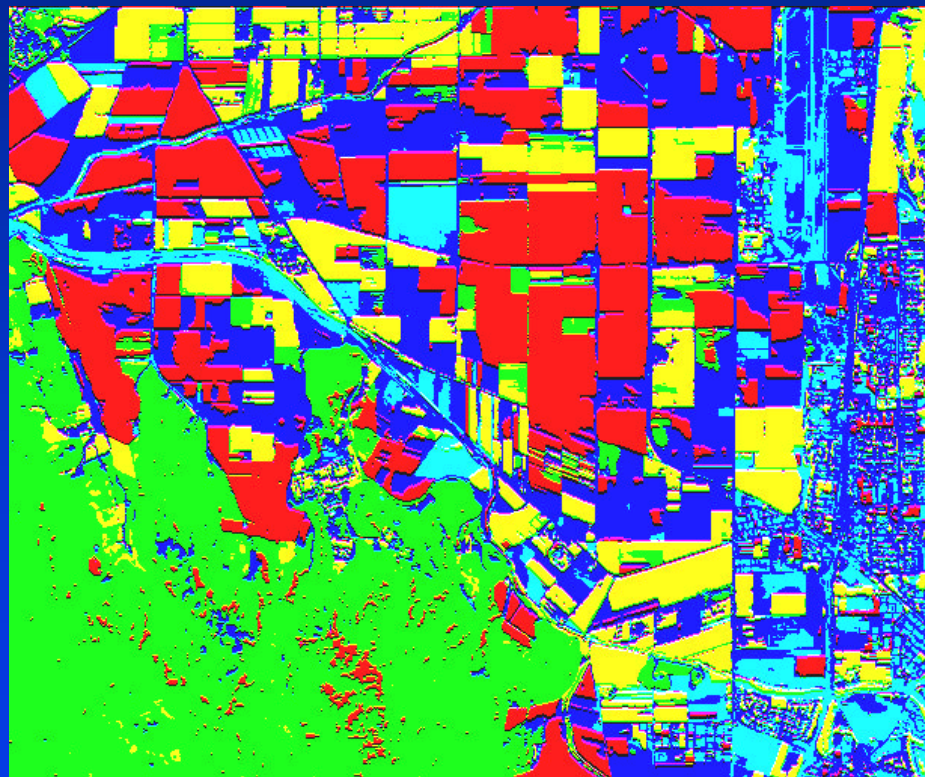
Performance of Spectral Angle Classification on Compressed/Reconstructed Data

- | Report % correctly classified pixels as function of compressed bit rate.
- | With appropriate profile, we get >99% accuracy with <1% of the data.

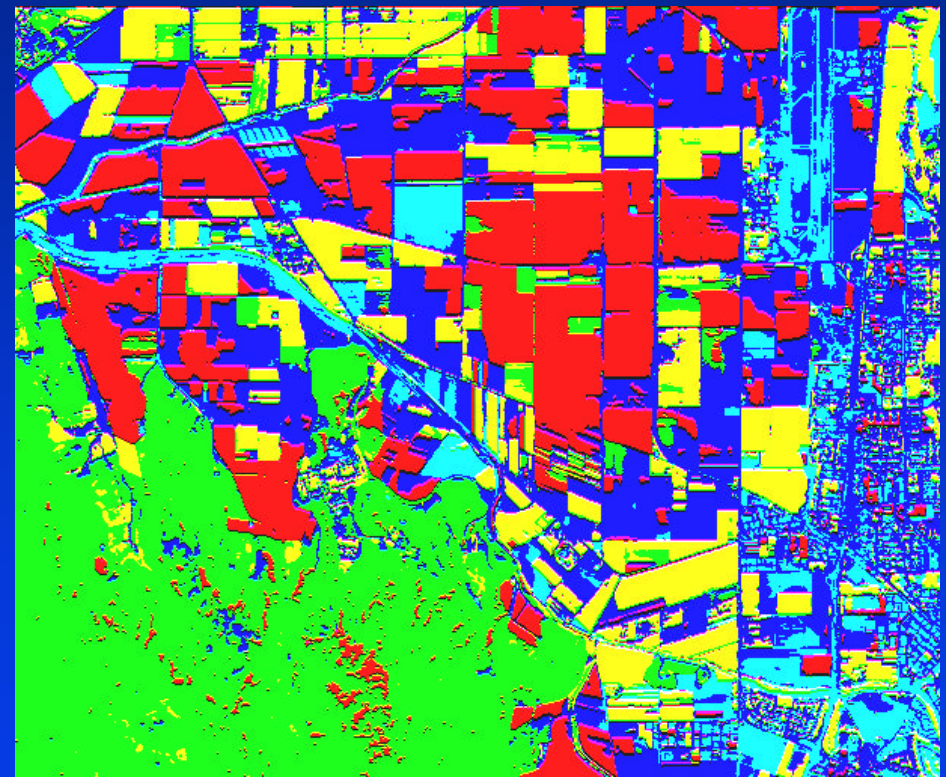


Example of Unsupervised Hyperspectral Data Classification: K-Means Clustering

| Classification of the uncompressed image



| Classification of the compressed/reconstructed image at 0.125 bits/pixel/band



Performance of K-Means Classification on Compressed/Reconstructed Data

- As before, with an appropriate JPEG-2000 compression profile, we get >99% classification accuracy with <1% of the data.

